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Citation: Boggess, Lyndsay, Perez, Deanna, Cope, Kathryn, Root, Carl and Stretesky, Paul (2014) Do medical marijuana centers behave like locally undesirable land uses? Implications for the geography of health and environmental justice. Urban Geography, 35 (2). pp. 315-336. ISSN 0272-3638

Published by: Taylor & Francis

URL: <http://dx.doi.org/10.1080/02723638.2014.881018>
<<http://dx.doi.org/10.1080/02723638.2014.881018>>

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Northumbria Research Link (www.northumbria.ac.uk/nrl)

Deposited in NRL:

19-February-2015

Item type:

Peer Reviewed Manuscript

Date of acceptance:

19-December-2013

Date of Publication:

05-February-2014

Citation for published item:

Lyndsay N. Boggess, Deanna M. Pérez, Kathryn Cope, Carl Root & Paul B. Stretesky. (2014) Do medical marijuana centers behave like locally undesirable land uses? Implications for the geography of health and environmental justice, *Urban Geography*, 35(3), 315–336.

DOI:

10.1080/02723638.2014.881018

URL to published item:

<http://dx.doi.org/10.1080/02723638.2014.881018>

Additional information:

DO MEDICAL MARIJUANA CENTERS BEHAVE LIKE LOCALLY UNDESIRABLE
LAND USES? IMPLICATIONS FOR THE GEOGRAPHY OF HEALTH AND
ENVIRONMENTAL JUSTICE

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Paper Accepted by Urban Geography on December 19th 2013
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Do Medical Marijuana Centers Behave Like Locally Undesirable Land Uses? Implications for the Geography of Health and Environmental Justice

Abstract: As of 2013, medical marijuana is legal in 20 states and the District of Columbia, but few studies have investigated the consequences of the retail centers that sell the drug. We draw upon the social construction literature to frame our research and help us determine whether medical marijuana centers in Denver, Colorado (USA) are considered locally undesirable land uses (LULUs). The geography of health and environmental justice frameworks lead us to hypothesize that marijuana centers are more likely to be opened in Hispanic, Black, and poor neighborhoods than in White and affluent neighborhoods. We also hypothesize that marijuana centers will tend to increase the minority composition and poverty of the neighborhoods in which they are located. Contrary to expectations we find no empirical support for these two hypotheses. Instead, results suggest marijuana centers are likely to be situated in neighborhoods with higher crime rates and more retail employment. Thus, despite the view by many planners and law enforcement officials that these centers are problematic, they do not take on LULU characteristics in siting and demographic changes. This finding, while limited to Denver, has important implications for policymakers who are considering similar marijuana policies.

Keywords: medical marijuana, environmental justice, minority, poverty, inequality

INTRODUCTION

Recently, Cummins (2007: 355) asserted that “the challenge in understanding neighbourhood effects in epidemiology has moved on from simply describing that ‘place’ matters independently of the ‘individual’ to identifying the plausible causal pathways by which neighbourhood social and material environment may affect health” (see also Curtis and Jones, 1998). In response to Cummins’s challenge, this study examines one type of land use that has the potential to create health disparities across the urban landscape in Denver, Colorado (USA, pop. 600,158). Specifically, we examine the demographic patterns associated with the establishment of 275 medical marijuana centers—distribution sites for patients who have been legally prescribed marijuana as a treatment for specified medical conditions. We are interested in determining whether medical marijuana centers are considered locally undesirable land uses (LULUs). It is likely that the stigma associated with marijuana, combined with some public officials’ claims that medical marijuana centers have deleterious consequences for communities (e.g., City of La Puente, 2008), renders marijuana distribution sites undesirable in neighborhoods. Further, since LULUs typically present problems that disproportionately affect minorities and the poor (Farber, 1998; Gorman et al., 2001; Kiel and McClain, 1995; Lipton and Gruenewald, 2002; Novak et al., 2006), we test whether the siting of medical marijuana centers has implications for both racial and economic inequality and environmental justice. This is particularly important given that medical marijuana centers may shape the geographic landscape that leads to social isolation and disparate health effects by race and class (Macintyre and Ellaway, 2003).

Therefore, our study seeks to determine if medical marijuana centers behave like LULUs in two important ways. First, we test if race, ethnicity, and/or income predict the future location

of medical marijuana centers across Denver neighborhoods. Specifically, we hypothesize that marijuana centers act like LULUs and are more likely to be opened in Black, Hispanic, and/or poor neighborhoods than in White and affluent neighborhoods. Second, we examine if the locations of medical marijuana centers create neighborhood conditions that increase social isolation over time. If medical marijuana centers mimic traditional LULUs then the siting of distribution centers should intensify the segregation of Blacks, Hispanics, and the poor, who are then disproportionately impacted by the negative consequences of the centers. This second question is particularly important because much of the current health geography literature is focused on how racial, ethnic, and economic segregation may increase over time as a result of the physical composition of places (Cummins, 2007; Macintyre and Ellaway, 2003).

MEDICAL MARIJUANA BACKGROUND

Though marijuana is the most widely used illicit drug in the United States (U.S. Department of Health and Human Services, 2012), the drug is considered to have some medical benefits, most notably for the treatment of cancer, glaucoma, epilepsy, and multiple sclerosis (Bostwick, 2012; Inciardi, 2008). The drug is also an appetite stimulant and has been used to reduce AIDS-related wasting and loss of muscle mass (Watson et al., 2000). In a 2011 study of medical marijuana patients in California, pain, insomnia, and anxiety were the most common conditions for which physicians recommended a medical marijuana regimen (Reinarman et al., 2011).

Twenty states and the District of Columbia have passed medical marijuana statutes, though the extent of the law varies by jurisdiction.² In 2000, voters passed Section 14 of Article XVIII of the Colorado Constitution.³ This amendment provides for the use of medical marijuana for patients who have an appropriately documented condition that is verified by a physician.

Initially, caregivers were restricted to providing medical marijuana to no more than five patients. Decisions in court and by the Board of Health in 2007 and 2009 effectively challenged this rule as arbitrary and won a victory for the medical marijuana center model. Regulations for the cultivation and distribution of medical marijuana were established in 2009 with the passage of Colorado SB 10-109 and HB 10-1284 via the Colorado Medical Marijuana Code. Notably, the code allows counties and cities to ban medical marijuana businesses in their communities (Jones and McCrimmon, 2012); however, in Denver only 10 neighborhoods have no centers. These centers are typically located in converted residential houses and neighborhood strip malls. Figure 1 depicts two typical marijuana centers in Denver.

[Figure 1 about here]

This amendment and the decisions that followed, combined with the “non-enforcement” approach of the U.S. attorney general at the federal level, led to a significant increase in the number of centers across the state of Colorado.⁴ Some commentators have referred to this as a “green rush,” and even Denver’s new police chief Robert White considers Denver the state’s marijuana capital.

On the other hand, marijuana is still regarded by the Controlled Substances Act as a relatively dangerous Schedule I drug (Hoffmann and Weber, 2010). Research has found negative mental health and behavioral consequences of continuous marijuana use, including inhibited development of social skills and coping strategies (Institute of Medicine, 1999; Brook et al., 1999). Relatedly, research suggests that arrests for marijuana possession have increased significantly across the United States (Nguyen and Reuter, 2012) as concerns about marijuana as dangerous and potentially a “gateway drug” to more serious drug use continue to influence policy decisions.

MEDICAL MARIJUANA CENTERS AS LULUS

Public support for medical marijuana is increasing, but widespread support for legalization does not yet exist (Pew Research Center, 2010). Despite the purported health benefits of medical marijuana, which are debatable (see Bostwick, 2012; Hall and Solowij, 1998; Inciardi, 2008), marijuana use still carries a social stigma. As the Pew Center (2010: 1) reported, nearly 45% of Americans surveyed reported that they would be “concerned if a store that sold medical marijuana opened near other stores in their area.” Most people (51%) would “feel uncomfortable” if someone were using marijuana around them (Pew Research Center, 2013). This suggests that medical marijuana centers may be seen as undesirable in neighborhoods.

The labeling of medical marijuana centers as LULUs can be understood in terms of the social construction of crime (Berger and Luckmann, 1967). From a social constructionist perspective meaning is assigned to an act or a behavior through a process of labeling by groups who seek to elicit a particular response. That is, something is defined as a crime or a social problem not based on the inherent nature of the behavior, but based on social responses to the behavior often instigated by the claims-making of a particular group. The construction of marijuana as criminal and immoral originated in the 1930s, when there was intense concern that the pharmacological effects of the drug caused “reefer madness” (Boyd, 2010) and would result in sudden and uncontrollable violence and murder (Musto, 1991). This perception was promulgated by the media (Inciardi, 2008) and intensified by former head of the Bureau of Narcotics Harry Anslinger, who in 1930 compared marijuana to a murderer and “as dangerous as a coiled rattlesnake.” As a result, marijuana use was stigmatized and users were described as deviants and criminals. Although research has generally not shown that marijuana use makes people more likely to engage in crime (e.g., Ostrowsky, 2011), the association between

marijuana use and criminal activity endures: a recent survey found that 32% of Americans consider smoking marijuana morally unacceptable and 38% believe that marijuana use will lead to harder drug use (Pew Research Center, 2010; 2013).

This view of marijuana is important because the stigma attributed to marijuana users carries over to medical marijuana centers that are, as a result, often described as undesirable and criminogenic. Law enforcement and public officials are two social actors that perpetuate the social construction of medical marijuana as problematic. First, law enforcement often suggests that marijuana centers may lead to crime. For instance, the California Police Chiefs Association's Task Force on Marijuana Dispensaries (2009: 14) notes,

On balance, any utility to medical marijuana patients in care giving and convenience that marijuana dispensaries may appear to have on the surface is enormously outweighed by a much darker reality that is punctuated by the many adverse secondary effects created by their presence in communities, recounted here. These drug distribution centers have even proven to be unsafe for their own proprietors.

Denver law enforcement has also adopted this view of medical marijuana centers. For example, a Denver detective stated that “across the state, we're seeing an increase in crime related to dispensaries . . . and that's just the crime that's being reported to us” (Ingold and Lofholm, 2011). In one instance a member of the regional drug task force (the North Metro Task Force) said that illegal behavior associated with marijuana centers' selling the drug “is becoming a huge problem. At the local law enforcement level it feels like it is spinning out of control in a lot of ways” (Mitchell and Parker, 2012).

Consistent with the law enforcement view of medical marijuana centers, city planners also often note that medical marijuana centers are LULUs because they increase crime, neighborhood disorder, and drug use (City of La Puente, 2008). Ordinances across the country have focused on medical marijuana center bans, most of which are justified by the negative

health and community aspects associated with medical marijuana outlets. For example, the City of La Puente (2008) states that “other cities with medical marijuana dispensaries have reported an increase in pedestrian and vehicular traffic and noise, increased loitering around dispensaries locations, increased incidents of burglary, and increased complaints from neighbors.” Opponents of the legalization of medical marijuana also argue that the presence of centers would hurt communities by drawing crowds of shady characters, increasing crime, and generally disparaging the neighborhood reputation (California Police Chiefs Association’s Task Force on Marijuana Dispensaries, 2009; Schworm, 2012).

Despite these claims, empirical research has yet to find any correlation between the location of these centers and crime (e.g., Freisthler, 2013; Kepple and Freisthler, 2012; Williams et al., 2011) and crime in general has decreased in Denver since the passage of Article XVIII (Mitchell, 2011). Further, a recent study investigating the consequences of a supervised intravenous drug injection facility (which may be also be undesirable in neighborhoods) shows that the facility functions as a therapeutic place that provides benefits to the individual user (e.g., reduced risk of overdose, social support, etc.) and to the community in general (Jozaghi, 2012). Thus, marijuana outlets are *perceived* as increasing community crime despite any evidence that they do. It is likely that people will not want to live near these facilities if they are perceived as generating crime and violence and decreasing property values in the places where they are located (see also Branas et al., 2009; Costanza et al., 2001; Ireland and Thommeny, 1993; Nielsen and Martinez, 2003; Roncek and Bell, 1981; Roncek and Maier, 1991). This means that medical marijuana centers are likely subjects of NIMBY (Not In My Backyard) sentiments. NIMBY facilities are sites (LULUs) that are considered to provide necessary or beneficial services by a majority within society but are not desired by people living near the facility’s

location due to perceived negative repercussions (Schively, 2007; Wolsink, 1994). Similar facilities include addiction treatment facilities (such as methadone maintenance centers) (Takahashi and Dear, 1997), adult sex shops (Hubbard et al., 2009), and group homes for people transitioning out of homelessness (e.g., halfway houses) (Martin, 2013). There is general opposition to the siting of these types of facilities for fear of impacts on quality of life or property value (Dear, 1992). With medical marijuana centers, residents may also fear potential health impacts from secondhand smoke or victimization from violent crime. This negative perception of medical marijuana centers likely influences the ability of the centers to establish only in neighborhoods where there is little local opposition. Further, this negative perception may lead to the kinds of changes in neighborhoods that may exacerbate social isolation, crime, and health over time. For example, the out-migration of more affluent households may leave behind an increasingly impoverished community that is more susceptible to potential negative health or crime consequences.

ENVIRONMENTAL JUSTICE

Recently, Cummins (2007) argued that while an understanding of the notion that places matter to health is important, geographers should also attempt to understand *why* they matter by looking for those causal factors that may shape health over time. One such factor may be the built environment of neighborhoods. That is, physical aspects of a neighborhood may help explain variations in health and health inequality across populations (Curtis and Jones, 1998; Wolch, 1979; Wolch and Dear, 1993) due to differential access to various forms of neighborhood capital. Further, neighborhoods may change over their life course; and in some cases create “spatial entrapment” whereby residents react to the physical aspects of a neighborhood (Smith and Esterlow, 2005). When neighborhoods change as a result of negative physical characteristics –

such as the establishment of a LULU – marginalized populations can become even more isolated, and perhaps increasing and concentrating levels of deviant behavior (Curtis and Jones, 1998). Thus, studies of urban health within geography should account for these time-variant processes when examining health outcomes.

Given this, we ask if medical marijuana centers are LULUs in that they are likely to be placed in poor and minority residential areas and may, because of their social stigma, contribute to racial, ethnic, and economic isolation over time. In short, these facilities appear to raise questions about environmental justice as they relate to health and geography (Bullard, 1990). Environmental justice refers to the right that all people have to “work, live, play and pray” in a healthy and safe environment (Bullard, 1990: xii). More specifically, inquiries under an environmental justice framework often examine “*who* gets *what* kind of environmental quality [and] *where* environmentally undesirable land uses get put, and *why*” (Been, 1995: 1).

Thus, like the health geography literature, the environmental justice literature focuses on the distribution of LULUs and their impact on changing community demographics (Stretesky and Hogan, 1998). Environmental justice scholars are interested in understanding how inequality in race, ethnicity, and income develop over time (Bullard, 1990). Kelly (2011), for instance, notes that LULUs are viewed as those land uses that people do not want to live close to, but which provide services to a community (DeVerteuil, 2000). Because of this, LULUs tend to establish in minority or poor communities (Liu, 2000) where there is less NIMBY opposition. As a result, social stratification is important as members of society do not equally share the burdens of LULUs. The environmental justice literature suggests that the least powerful members of society bear the greatest environmental burdens (Bowen, 2002; Lui, 2000). LULUs examined within the environmental justice literature are typically associated with garbage incinerators,

dumps, and factories that release significant toxins into the environment. But the definition of LULUs within the environmental justice literature has changed over time and includes a variety of different undesirable outcomes that can be considered social justice issues (Kelly, 2011). As a result the concept of environmental justice has been applied to prison siting (Braz and Gilmore, 2006) and the distribution of liquor stores (Romley et al., 2007): services that are useful and desired but which most people would not want in their neighborhood. According to this broader perspective, many types of LULUs can detrimentally affect health by encouraging social isolation and a variety of bad behaviors that also have health consequences (Costanza et al., 2001; Gorman and Speer, 1997; Horgen and Brownell, 2002). For example, the presence of alcohol outlets has been shown to increase individual alcohol consumption (Weitzman et al., 2003), arrests for public drunkenness and impaired driving (Gruenewald et al., 2002; Treno et al., 2003), and the neighborhood rate of violent crime (Gorman et al., 2001; Lipton et al., 2013; Scribner et al., 1999; Scribner et al., 1995).

Further, undesirable physical establishments can contribute to negative changes over time in the community (Smith and Easterlow, 2005). LULUs cause neighborhoods to become less desirable (i.e., to have greater health risks, higher crime rates, lower property values, etc.), and households with the financial means generally leave. The ability to exit an undesirable neighborhood is also correlated with race or ethnicity, as minority residents typically have fewer resources and more limits on where they can move (Massey and Denton, 1988). As a consequence, this leaves behind concentrations of impoverished minority communities that are unable to oppose future LULUs (Wilson, 1987) and creates a cycle of poverty, diminished property values, and negative health outcomes (Smith and Easterlow, 2005). As these places become more isolated over time, they also exhibit adverse health consequences such as higher

infant mortality (Grady and Darden, 2012) that disproportionately burden minorities and the poor.

DATA AND METHODS

In order to examine the racial/ethnic and economic disparities in the siting of medical marijuana centers and their potential impact on future inequality, we study 275 medical marijuana centers in 75 Denver neighborhoods.⁵ Neighborhoods are official designations by the City of Denver that approximate census tracts. We believe that neighborhoods are analytically preferable to census tracts as units of analysis, as they have cultural identity (Williams, 1999). In the case of Denver neighborhoods, city ordinances emphasize their political importance by engaging neighborhood organizations in cooperative and collaborative governance (Registered Neighborhood Organizations ordinance, 2005; Kathi and Cooper, 2005). Similarly, it is likely that retailers see neighborhoods in terms of business and sales activity, socioeconomics, crime, and other characteristics. In addition, many of the neighborhoods have associations comprised of local residents, which could be an organized tool to combat LULUs. Neighborhoods tend to be larger than census tracts, and the average population in Denver neighborhoods in 2000 was 7,363 residents. On average, Denver neighborhoods are 30% Hispanic and 9.6% Black, and the median household income is \$56,128.

We obtained data on neighborhood characteristics from the Piton Foundation (2004), a private foundation dedicated to assisting low-income families in Denver.⁶ One of the Piton Foundation's major initiatives is the collection, organization, and dissemination of Denver demographic data (see Kingsley and Pettit, 2011). The data initiative gathers information about a variety of social and economic factors, including race, ethnicity, economic status, and crime, provided by various agencies including the Census Bureau, the Denver Police Department, and

the City and County of Denver. To test whether medical marijuana centers act as LULUs, we use data from 2000 to account for the neighborhood demographics *prior* to the siting of the medical marijuana facility.⁷ To test the impact of medical marijuana centers on increased social and economic isolation, we utilize data from the American Community Survey five-year averages (2006–2010) to test the decadal change between 2000 and 2010 values.

PREDICTING MEDICAL MARIJUANA SITING

In order to address our first research objective—investigating the siting of medical marijuana facilities in neighborhoods—we use negative binomial regression (NBR) with robust standard errors. We argue that if medical marijuana centers act as LULUs, they would be more likely to open in neighborhoods that are disproportionately Black, Hispanic, and poor. To test this, our dependent variable is the number of medical marijuana centers per neighborhood. Medical marijuana centers that we study are businesses that sell marijuana to patients with a registry identification card from the Colorado Department of Public Health and Environment. As Figure 1 suggests, these businesses are generally easily identifiable from the street because of their heavy advertising, but a few are located in more concealed locations, such as inside an office building. All center transactions take place in person and none involve vending machines or other mechanized sale devices. We used ArcGIS to geocode a list of facilities according to addresses provided by the Denver City Council for all medical marijuana facilities in 2010; all 275 centers on that list were successfully mapped. There are 3 or 4 centers per neighborhood on average, with a range of zero centers to 19 centers in the neighborhood of Five Points. A map indicating the distribution of medical marijuana centers is shown in Figure 2 below.

[Insert Figure 2 here]

TESTING ISOLATION EFFECTS

In order to address our second research hypothesis—that the presence of medical marijuana centers contributes to increased isolation by race, ethnicity, or poverty—we use ordinary least squares regression (OLS) with robust standard errors. The dependent variables are change in the percent Hispanic residents, change in the percent Black residents, and change in the percent of residents in poverty between 2000 and 2010. We calculate change as the difference between the 2010 value and the 2000 value in (1) percent Hispanic, (2) percent Black, and (3) percent in poverty. On average, neighborhoods with medical marijuana facilities saw a 0.54% *decrease* in the Hispanic population and a 0.62% *decrease* in the Black population. In neighborhoods without medical marijuana facilities, neighborhoods averaged an increase of nearly 3% Hispanic and an increase of 5.6% Black. Poverty increased similarly in both types of neighborhoods: up 4.87% in medical marijuana neighborhoods versus 4.7% in neighborhoods without medical marijuana facilities.

INDEPENDENT VARIABLES OF INTEREST

We focus on the siting of medical marijuana facilities in relation to minority-dominated or economically disadvantaged neighborhoods to test our first hypothesis that medical marijuana centers are more likely to be opened in neighborhoods that are Black, Hispanic, and/or poor than in neighborhoods that are affluent and White. Given that previous studies have found differential effects based on minority race or ethnicity (e.g., Been and Gupta, 1997), we separate the percentage of Hispanics and Blacks rather than creating a single “non-White” indicator. Our three independent variables of interest are (1) the proportion of Hispanic residents, (2) the proportion of Black residents, and (3) the proportion of a neighborhood’s residents living below the federally determined poverty level (\$17,050 for a family of four). If medical marijuana centers are LULUs, then the proportion of Blacks, Hispanics, and the poor should increase as

medical marijuana centers increase across Denver's neighborhoods. Such a finding would indicate that marijuana centers tend to be opened in more segregated neighborhoods, as is the case with more traditional LULUs such as garbage incinerators and heavily polluting facilities (Bullard, 1990).

CONTROL VARIABLES

In addition to demographic measures of race, ethnicity, and poverty, we also examine eight other variables likely related to the siting of marijuana facilities and demographic changes over time. First, we include a measure of the neighborhood crime rate. We predict that neighborhoods with a higher crime rate will be more likely to have medical marijuana centers and may also be more racially and economically isolated. In part, this is because high-crime neighborhoods often have other forms of disadvantage, such as high poverty rates. It is also plausible that high-crime neighborhoods have lower collective efficacy and are less able to fight against medical marijuana facilities moving in (Sampson et al., 1997; Taylor, 2000). We measure the crime rate per 100 neighborhood residents for all Part 1 violent and property offenses.⁸ On average, a neighborhood has 0.935 incidents of crime per 100 residents.

Second, we include a measure of residential instability. We measure residential instability as the proportion of residents who did not live in Denver during the previous five years.⁹ Residential instability has long been linked to higher crime rates (e.g., Shaw and McKay, 1942) since population fluctuation can impact social networks and the ability of neighborhoods to maintain social control. Instability is also a key factor in the perpetuation of urban disadvantage in Black communities, according to Sampson and Wilson (1995) and Wilson (1987); as households with the financial means leave disadvantaged or high-crime neighborhoods, the community will be less likely to defend itself and fend off negative or undesirable businesses

(see also Boggess and Hipp, 2010; Silverman and Segal, 1996). This process can further perpetuate the social isolation that predominantly minority neighborhoods face (Sampson and Wilson, 1995). The average neighborhood has 27.9% new residents.

Third, we predict that medical marijuana centers will be more likely to relocate into neighborhoods that already have a strong retail presence, given that it is these areas that already have the proper business zoning permits needed for the centers. Therefore, we include a measure of retail employment that represents the percentage of all retail trade jobs as a percent of total jobs by neighborhood during 2000.¹⁰ This measure is in line with extant environmental justice research on the siting of toxic facilities, which accounts for the potential employment base by including the percent manufacturing employees (e.g., Anderton et al., 1994; Pastor et al., 2001).

We create a fourth variable to control for the number of primary roads in a neighborhood under the likelihood that ease of access to the facility is a business consideration for the centers.¹¹ This variable is also in line with prior research by Wilcox and Ecks (2011), who argue that traffic may be the driving factor for the association between particular types of facilities and crime. More specifically, they argue that “a high-traffic church might be as bad for a neighborhood as a high-traffic bar, and a low-traffic bar might be more beneficial than a high-traffic church” (Wilcox and Ecks, 2011: 475). Thus, we believe that the number of major roads in a neighborhood should be positively related to the number of centers.

While certain neighborhood factors such as economic disadvantage and minority concentration may attract centers, other neighborhood conditions may actually insulate neighborhoods from unwanted land uses. A neighborhood that has more wealth, political power, or social capital may be able to organize effectively and stop a center siting. In order to compare the influence of disadvantage relative to the protective factors, we include indicators of median

household income, the average value of homes sold, and the proportion of residents 18 or older who voted in the last election to account for neighborhood economic and political advantage. Finally, the eighth control variable accounts for neighborhood population size. We anticipate that neighborhoods with a larger population may be more attractive to marijuana centers since it would represent a larger source of potential consumers.¹²

SPATIAL EFFECTS

It is likely that the presence of medical marijuana facilities in one neighborhood may have a diffusion effect on nearby areas and affect the likelihood of a medical marijuana center's being located in the surrounding neighborhoods. Research has shown that social behaviors can cluster or display patterns over geographical space (Deane et al., 1998), and researchers have explained the diffusion of social phenomena such as church membership (Land et al., 1991) and homicide (Cohen and Tita, 1999) across community boundaries in terms of spatial processes. Therefore, we include a spatial lag of the number of medical marijuana facilities in the spatially contiguous neighborhoods. We computed the spatial lag in GeoDA using the queen case. The spatial lag also corrects for spatial autocorrelation, or the clustering of like values (such as the clustering of neighborhoods with a high number of medical marijuana centers).¹³

There is no evidence of multicollinearity in our analysis; all variance inflation factor (VIF) scores were less than 5 (scores greater than 10.0 are considered harmful and may distort statistical significance tests; see Kennedy, 2008).

RESULTS

DESCRIPTIVE STATISTICS

Prior to conducting the multivariate analysis we first examined differences between neighborhoods with medical marijuana centers ($n = 65$) and neighborhoods without such

establishments ($n = 10$). Average neighborhood characteristics for Denver neighborhoods, broken down into neighborhoods with and without centers, are shown in Table 1, below. We use two-tailed Welch t-tests to examine statistical significance between the medical marijuana neighborhoods and the non-medical marijuana neighborhoods.¹⁴

[Table 1 about here]

Table 1 reveals that there were some differences between neighborhoods that would become hosts to medical marijuana facilities and those that would not have a medical marijuana facility site. It shows that medical marijuana neighborhoods have a larger Hispanic population and a greater percentage of residents living below the poverty level. In 2000, future medical marijuana neighborhoods had a higher Hispanic population (32.39%) and a lower Black population (7.94%) than neighborhoods that would not host medical marijuana sites (16.72% and 20.18%, respectively). The neighborhoods that would have medical marijuana facilities had an average poverty rate of 15.94% in 2000, whereas non-medical marijuana neighborhoods had a poverty rate of only 10.3%. Additionally, the average crime rate in future medical marijuana neighborhoods was more than twice as large (1 per 100 residents) as the average crime rate in other neighborhoods (0.49 per 100 residents).

The t-tests reveal that only some of these differences are statistically significant. There is a statistically significant difference in the mean percent of Hispanics ($P < 0.01$), the mean poverty rate ($P < 0.10$), the crime rate ($P < 0.01$), and the number of roads ($P < 0.05$). The difference between the size of the Black population in medical marijuana neighborhoods and its size in those without is not significant. This suggests that there may be an environmental justice concern with the percent of Hispanics and poor residents who are exposed to medical marijuana

centers, but to more closely examine whether or not racial/ethnic composition and poverty directly impact medical marijuana siting, we next turn to our negative binomial models.

PREDICTING MEDICAL MARIJUANA SITES

Results of our negative binomial regression analysis are shown in Table 2. In addition to the coefficients and the incidence rate ratio, we also calculated the predicted percent change in the number of medical marijuana centers using the formula $(\exp(\beta) - 1) * 100$ (see Long, 1997).

[Table 2 about here]

The primary goal of this analysis was to determine if the race, ethnicity, and poverty of neighborhoods is associated with the number of medical marijuana centers even after controlling for other neighborhood characteristics. Though we expected that centers would be more likely to be located in neighborhoods that are minority-dominated and impoverished, we do not find evidence of this. The proportion of Hispanic residents ($B = 0.042$, $P = 0.954$), the proportion of Black residents ($B = -1.582$, $p = 0.232$), and the percent of residents below poverty ($B = 1.017$, $P = 0.680$) are not statistically significant predictors of medical marijuana centers in the neighborhood. In additional models (results not shown), interactions between race/ethnicity and poverty rates were also non-significant.

The two strongest predictors of medical marijuana siting are the crime rate ($B = 0.387$, $p < 0.05$) and the proportion of retail jobs ($B = 2.325$, $P < 0.05$). This means that for each additional crime per 100 residents, the number of medical marijuana facilities is predicted to increase by 51% and that as the proportion of retail employment increases from no employment to complete retail employment there is a 22% increase in the siting of marijuana centers. Three additional variables approach significance: residential instability ($B = -2.310$, $P < 0.10$), the number of major roads ($B = -0.251$, $P < 0.10$), and the total population ($B = 0.059$, $P < 0.10$).

The direction of the relationship between residential instability and centers is contrary to what we had expected. That is, neighborhoods with a greater number of new residents are predicted to have 20% fewer centers. Interestingly, the number of marijuana facilities in nearby neighborhoods is not a significant predictor of medical marijuana centers in the focal tract. These results suggest that there is no health disparity in the siting of medical marijuana facilities and that there is little support for our first hypothesis that marijuana centers are located in neighborhoods that are disproportionately Black, Hispanic, or poor. Thus, in contrast to other environmental justice research that typically examines environmental hazards, medical marijuana centers do not appear to behave as typical LULUs as they are distributed equally with respect to race, ethnicity, and poverty.

TESTING ISOLATION EFFECTS

The negative binomial regression results suggest that despite statistically significant differences in the mean percent Hispanics and poverty (see Table 1), these factors are *not* meaningful predictors of the siting of medical marijuana facilities (Table 2). We next turn our analysis to our second hypothesis to determine whether or not the presence of medical marijuana centers significantly increases the minority or poor population in a neighborhood between 2000 and 2010. If this is the case, medical marijuana centers may act as LULUs by increasing racial and ethnic isolation and in the potential health impacts that accompany that isolation. The results of that second hypothesis test are shown in Table 3, below.

[Table 3 about here]

To predict change in racial/ethnic composition and poverty between 2000 and 2010 we used mostly the same variables that were used to predict medical marijuana center siting, with the exception of the percent retail employees and total population.¹⁵ Model 1 shows the effect of

medical marijuana facilities on the neighborhood change in the percent Hispanic population ($B = -0.964, P < 0.001$). Again, contrary to theoretical expectation, the results indicate that the presence of medical marijuana facilities led to a *decrease* in the size of the Hispanic population over the 10-year period between 2000 and 2010. Furthermore, the presence of medical marijuana facilities in the nearby neighborhoods is also associated with a decrease in the percent Hispanic residents in the focal neighborhood ($B = -1.035, P < 0.01$). This means that for each additional medical marijuana facility in the neighborhood, the average change in the percent Hispanic residents is a 0.96% decrease. For each additional medical marijuana center in the surrounding neighborhoods, the percent Hispanic residents in the focal neighborhood decreases 1.035%. These are large effects given that the average neighborhood Hispanic population decreased less than 1%. Other significant predictors of the change in the size of the Hispanic population include the neighborhood crime rate in 2000 ($B = 2.695, P < 0.01$) and the percent of residents living in poverty in 2000 ($B = -0.348, P < 0.01$).

Turning to Model 2, it is clear that the presence of medical marijuana facilities does not have the same impact on the size of the Black population. Only the presence of medical marijuana centers in the surrounding neighborhoods is significantly and positively related to the change in the percent Black residents in the focal neighborhood ($B = 0.867, P < 0.01$); medical marijuana sites are not significant predictors of the size of the Black population in their own neighborhood. This means for each additional medical marijuana facility in the nearby neighborhoods, the size of the Black population in the focal neighborhood increases 0.867%. Since the average change in the percent Black is -1.28 (see Table 1), an additional one marijuana center in the nearby neighborhoods will decrease the average Black population 0.413%; two medical marijuana facilities will ultimately lead to an increase of 0.45% in the percent Black

residents. Interestingly, the median sales price of single-family houses was not a significant predictor of change in either the Black or the Hispanic population. In short, medical marijuana centers do not appear to act as typical LULUs in that they don't contribute to racial isolation over time (Mohai and Saha, 2006).

Medical marijuana centers also do not contribute to increases in neighborhood poverty. As shown in Model 3 in Table 3, the number of centers in a neighborhood ($B = -0.296$, $P = 0.145$) and the number of medical marijuana centers in adjoining neighborhoods ($B = -0.437$, $P = 0.341$) are not significantly associated with changes in the poverty rate. This suggests that medical marijuana centers do not act as LULUs in that they do not contribute to increased poverty over time.

DISCUSSION AND CONCLUSION

The geography of health and environmental justice literature suggests that the distribution of LULUs has the potential to isolate disadvantaged populations, and that social isolation may be indirectly related to a variety of adverse health outcomes. This study draws upon the environmental justice and health geography frameworks to argue that the social construction of marijuana is likely to contribute to the view that medical marijuana centers are LULUs. As a result, we set out to test two hypotheses that demand greater attention within those literatures. First, we suggest that marijuana centers are more likely to be opened in Black, Hispanic, and/or poor neighborhoods than in White and affluent neighborhoods. Second, we argue that medical marijuana centers will intensify the social isolation of Blacks, Hispanics, and the poor over time. While our bivariate analysis reveals that neighborhoods with medical marijuana facilities tend to have higher poverty rates and larger minority populations, these factors are not significant predictors of the siting of marijuana centers once other neighborhood demographic and business-

related factors are controlled. In short, we find no empirical support for the hypothesis that medical marijuana centers are sited in disproportionately Black, Hispanic, or poor neighborhoods. As a result, we conclude that medical marijuana centers do not appear to be a typical LULU since there is little evidence of inequality in their placement.

Moreover, we might question the extent to which these centers are actually considered LULUs by the residents of Denver. It is likely that Denver residents are aware of the controversy surrounding medical marijuana and medical marijuana centers. For example, Burby and Strong (1997) report that residents are vigilant about the presence of LULUs when deciding where to live. This observation raises interesting questions about the social construction of marijuana centers. While public officials, and especially law enforcement, clearly warn residents about the negative effects of these centers on the communities in which they are situated, there is little evidence that residents are listening, as these centers do not appear to have any impact on the urban landscape—and therefore on the health of the communities in which they are located. This suggests that it is not enough for officials to define something as harmful; the community must also accept that definition of harm (Berger and Luckmann, 1966). This finding also appears to suggest that despite the pervasive stigma of marijuana in the United States, social norms regarding the drug have changed over time. Indeed, Colorado residents did vote to allow the use of marijuana for medical purposes and more recently (2012) have voted in favor of full legalization of the drug, including for recreational purposes (Amendment 64) (for more information see “Colorado Amendment 64” in the *Huffington Post*).

It is important to point out that while medical marijuana centers do not appear to be opened disproportionately in disadvantaged neighborhoods they are more likely to be opened in areas that have higher crime rates. This could be the case because crime tends to follow retail

(Bamfield, 2004; Brown, 1982). Thus, neighborhoods that have large strip malls and other forms of retail establishment are almost certainly likely to have more crime. Indeed we also find strong evidence that the retail presence in a neighborhood drives medical marijuana center siting. This is analogous to earlier studies that have shown a consistent association between manufacturing employment and the presence of toxic facilities (e.g., Been, 1995; Pastor et al., 2001).

Neighborhoods with a strong retail presence provide the center with land already zoned for commercial use as well as a large pool of potential employees (and possibly clients), and it is also likely the case that these neighborhoods have more existing retail establishments and are friendlier to commercial business. In short, medical marijuana facilities appear to us to be more similar to drugstores and coffee houses than they are to LULUs.

We were also interested in determining whether the presence of medical marijuana facilities contributes to increased racial/ethnic concentration or increased poverty over time. For instance, Been (1995) has argued that environmental justice occurs more indirectly as a result of market forces that push minorities into neighborhoods with LULUs. This position echoes concerns in the health geography literature that the physical aspects of a neighborhood can serve to isolate the disadvantaged. We also assessed this impact of medical marijuana centers on the change in neighborhood percent Black residents and the change in percent Hispanic residents while controlling for market factors such as median household income, residential stability, and median home price. We found no evidence of increased disadvantage or minority concentration post-medical marijuana center; in fact, our results suggest that the presence of medical marijuana facilities leads to a decrease (as opposed to an increase) in the size of the Hispanic population and has no effect on the size of the Black population. Other researchers have found a negative relationship between the presence of a LULU and the minority population (Oakes et al., 1996).

Pastor et al. (2001) concluded that the presence of a hazardous waste site repels rather than attracts minorities. But in Denver this decrease in Hispanics does not follow the pattern of other suspected LULUs. For instance, Shaikh and Loomis (1999) studied air pollution in Denver and discovered that there are greater increases in the minority population in areas with polluting facilities than in areas without such polluting facilities. This suggests that the presence of a medical marijuana center in a neighborhood does not contribute to a greater concentration of minority residents and may in fact repel minority residents.

We found clear evidence that geography matters for the increased spatial isolation of Blacks and Hispanics. More specifically, increases in the presence of medical marijuana centers in the nearby area leads to a decrease in the Hispanic population and an increase in the Black population in the focal neighborhood. It is possible that the Hispanic population responds more negatively to medical marijuana centers and that Hispanic households are quicker to relocate when such facilities move in. In fact, data from the Pew Research Center (2013) shows that Hispanics are somewhat less likely to support marijuana legalization and are much less likely to use marijuana (for any purpose). Therefore, Hispanic households may be particularly sensitive to medical marijuana centers—whether in their own neighborhood or nearby—and choose to live farther from such facilities. For Hispanics alone, medical marijuana centers may in fact be LULUs and future research should uncover the racial/ethnic disparities in response to medical marijuana sites.

The presence of medical marijuana centers in nearby neighborhoods has the opposite effect for the Black population in the neighborhood: as the number of marijuana facilities in geographically proximate neighborhoods increases, the percent Black residents in the focal neighborhood also increases. Notably, medical marijuana centers in the focal neighborhood are

not associated with change in the percent Black residents. This could reflect limited opportunities for Blacks to move into more desirable neighborhoods. That is, Black households more than any other group still face discrimination in the housing market and when Black households relocate, they are often restricted to neighborhoods that have higher minority populations (Hipp, 2011). Therefore, the true case could be that Black households are moving from neighborhoods with medical marijuana centers into the focal neighborhoods irrespective of medical marijuana centers because of limited access to areas that have lower crime rates.

This paper is the first of its kind to investigate the relationship between race, ethnicity, poverty, and the distribution of medical marijuana facilities. Despite our best efforts to accurately locate marijuana centers, control for relevant variables, and pay attention to the time ordering of variables there are still drawbacks associated with our study. First, this is a study of marijuana centers in one state that supported the legalization of marijuana for medical purposes. As a result there may be less of a tendency for the residents of Colorado to view these centers as LULUs when compared to other states where there are more regulations on the sale of medical marijuana and where centers are not as common. Moreover, these results may not be generalizable over time. If this study were carried out at a different point in time it might generate a different outcome. For example, the legalization of medical marijuana is only a recent phenomenon that has certainly had some impact on public opinion about the drug. Moreover, if the federal government begins cracking down on the sale of marijuana it could serve to change public opinion about the drug in the future so that marijuana centers come to be considered LULUs by residents. Another weakness of the study is that we do not know the long-term implications of medical marijuana centers. It might be the case that ten years is not a long-enough time period to accurately assess neighborhood changes.

We conclude by pointing out that this research has policy implications for those states considering a medical marijuana approach similar to Colorado's. In short we suggest to policymakers who are looking to determine whether medical marijuana centers are harmful to a city that the centers do not appear to be problematic in Denver. They are not concentrated in poor and minority neighborhoods and they do not appear to increase social isolation and segregation in a city over time. As a result we suggest that medical marijuana centers do not behave as LULUs and therefore have relatively few negative health effects on minorities and the poor as a result of their location in Denver. However, because marijuana is a social construction that may vary across place and time we encourage the replication of our study in other states that have chosen to dispense medical marijuana through retail centers.

ACKNOWLEDGMENTS

The authors would like to thank two anonymous reviewers for their helpful suggestions. An earlier version of this paper was presented at the American Society of Criminology Annual Meetings on November 19, 2010 in San Francisco, CA.

NOTES

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² As of 2013, the other states are: Alaska, Arizona, California, Delaware, Hawaii, Illinois, Maine, Michigan, Montana, Nevada, New Hampshire, New Jersey, New Mexico, Oregon, Rhode Island, Washington, and Vermont.

³ Our study focuses on Denver since Colorado is one of the few states that passed medical marijuana legislation that allows for the nearly unrestricted establishment of facilities.

⁴ In October 2009, Deputy Attorney General David W. Ogden released a memorandum to states that passed laws authorizing the legal dispensing of marijuana for medical purposes. The “Ogden memo” essentially established a policy of federal non-enforcement for individuals and commercial enterprises involved in the legal use and sale of medical marijuana. The Ogden memo was later followed by a statement from the Obama administration in 2011 that clarified that the federal government will continue to investigate and prosecute the commercial cultivation, sale, and distribution of marijuana as violations of the Controlled Substances Act, regardless of state law.

⁵ There are 78 total neighborhoods in Denver but three neighborhoods were dropped due to missing data, bringing the final N to 75 neighborhoods. We obtained a map of all dispensaries from the Colorado Department of Public Health and Environment in 2010. We first coded dispensaries listed on that map by neighborhood by hand. Next, an electronic version of the dispensary list, along with the exact addresses, was obtained from the Department of Public Health and Environment in April 2011. The researchers used this second list to verify coding by neighborhood and to check that dispensaries were located at the address provided. Our final list confirmed that the location and number of dispensaries on the initial list were correct. Data on dispensaries are updated constantly and can be retrieved from <http://www.cdphe.state.co.us/hs/Medicalmarijuana/statistics.html>.

⁶ The Piton Foundation publishes studies on various issues that impact Denver, Colorado. For example, the foundation and its scholars have produced data used in published reports and articles on issues such as juvenile delinquency (Piton Foundation, 1999), neighborhood risk (Lucero, 2012), and housing vouchers and crime (Ellen et al., 2012). For more detailed information about the Piton Foundation data see Kingsley and Pettit (2011).

⁷ Remember that Colorado passed the medical marijuana law in 2000, so there were no legal outlets for marijuana sales prior to 2000.

⁸ Part 1 crimes include homicide, rape, robbery, aggravated assault, burglary, theft, and auto theft.

⁹ We recognize that a better control for urban influx would include intra-city turnover as well as inter-city turnover.

This is a limitation in the Piton data. We thank a reviewer for pointing out this issue.

¹⁰ Retail trade jobs includes employees in (1) general merchandise, (2) automobile, (3) food, (4) furniture, (5) eating and drinking, and (5) miscellaneous retail employment.

¹¹ The locations of primary roads are available in the Census 2000/Tiger line files

(<http://www.census.gov/geo/www/tiger/>) and are composed of class 1, 2, and 3 road segments that include

highways, state highways, and other major and minor roads that connect those roads to highways and interstates.

Primary roads exclude most roads in the United States that are defined as neighborhood roads.

¹² We also test population density as an alternative to population size. The models that include population density in place of population are substantively similar to the models presented in this analysis. Results available from authors upon request.

¹³ In addition, we verified the presence of spatial autocorrelation using the Moran's I (0.108, $p < 0.05$).

¹⁴ Welch's t -test is superior to the Student t -test when the sample variances are unequal and the sample sizes are markedly different. In such situations, using Welch's t -test reduces the likelihood of a Type 1 error (Welch, 1937).

¹⁵ Since the dependent variable was constructed using rates, the neighborhood population is already accounted for in the model. We did not feel that the percent residents working in a neighborhood would be an important consideration for either moving in or out of a neighborhood specifically by race/ethnicity, but we did include percent retail in the model predicting change in poverty.

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TABLE 1. AVERAGE NEIGHBORHOOD CHARACTERISTICS FOR ALL DENVER NEIGHBORHOODS AND BY THE PRESENCE OF MEDICAL MARIJUANA DISPENSARIES

| | All Denver neighborhoods (N = 75) | | Neighborhoods with at least 1 medical marijuana dispensary (N = 65) | | Neighborhoods with no medical marijuana dispensaries (N = 10) | | T- test |
|--|--------------------------------------|-----------|--|-----------|--|----------|------------|
| | Mean | S.D. | Mean | S.D. | Mean | S.D. | |
| Medical marijuana dispensaries | 3.65 | 3.56 | 4.22 | 3.5 | -- | -- | |
| Total population | 7,363 | 4,433 | 7,551 | 4,616 | 6,145 | 2,866 | |
| Percent Hispanic residents | 30.3 | 25.6 | 32.4 | 26.7 | 16.7 | 9.9 | ** |
| Percent Black residents | 9.57 | 15 | 7.9 | 12.3 | 20.2 | 25 | |
| Percent in poverty | 15.2 | 11.4 | 15.9 | 11.7 | 10.3 | 8.0 | * |
| Total crime rate (per 100) | 0.93 | 1.07 | 1.00 | 1.23 | 0.49 | 0.29 | |
| Percent new residents (instability) | 27.9 | 9.9 | 28.0 | 9.4 | 27.0 | 12.9 | *** |
| Median household income | \$56,128 | \$25,442 | \$55,390 | \$26,442 | \$60,926 | \$17,899 | |
| Average home sales price | \$228,888 | \$111,731 | \$226,872 | \$115,237 | \$241,989 | \$89,398 | |
| Percent retail employees | 14.0 | 8.4 | 14.2 | 8.3 | 12.8 | 9.6 | |
| Percent voting residents | 16.1 | 7.0 | 15.8 | 7.1 | 18.0 | 6.6 | |
| Number of major roads | 1.53 | 0.9 | 1.62 | 0.9 | 1 | 0.8 | * |
| Change in the percent Latino population between 2000 and 2010 | -0.73 | 9.26 | -0.54 | 9.37 | 2.94 | 8.32 | |
| Change in the percent Black population between 2000 and 2010 | -1.28 | 5.26 | -0.62 | 4.27 | -5.58 | 8.58 | † |

Note: Two-tailed Welch t-test, †p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001

TABLE 2. PREDICATED PERCENT CHANGE IN THE NUMBER OF MEDICAL MARIJUANA DISPENSARIES ACROSS DENVER NEIGHBORHOODS, CALCULATED FROM NEGATIVE BINOMIAL REGRESSION WITH ROBUST STANDARD ERRORS, N = 75

| | B | SE | | IRR | Percent change |
|--|----------|-----------|---|------------|-----------------------|
| Proportion Hispanic | -0.042 | 0.729 | | 0.959 | -1% |
| Proportion Black | -1.582 | 1.322 | | 0.201 | -21% |
| Poverty | 1.017 | 2.467 | | 2.764 | 12% |
| Crime rate (per 100 residents) | 0.387 | 0.176 | * | 1.473 | 51% |
| Residential instability | -2.310 | 1.314 | † | 0.099 | -20% |
| Median household income | -0.010 | 0.007 | | 0.990 | -23% |
| Average home sales price | 0.091 | 0.146 | | 1.095 | 11% |
| Retail employment | 2.325 | 1.168 | * | 10.227 | 22% |
| Number of major roads | -0.251 | 0.137 | † | 0.778 | -21% |
| Percent voting residents | 0.275 | 1.561 | | 1.317 | 2% |
| Total population | 0.059 | 0.031 | † | 1.060 | 30% |
| Spatial medical marijuana dispensaries | 0.0004 | 0.560 | | 1.000 | <1% |
| Alpha | 0.3407 | 0.103 | | | |
| Log likelihood | -166.99 | | | | |

Note: The percentage change is associated with a 1-unit increase in the independent variable and was calculated using the following transformation on the standardized independent variables: $[(\exp \beta) - 1]100$ (see Long, 1997).

†p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001

TABLE 3. ORDINARY LEAST SQUARES REGRESSION RESULTS PREDICTING 2000 TO 2010 CHANGE IN THE PERCENT HISPANIC, CHANGE IN THE PERCENT BLACK, AND CHANGE IN PERCENT IN POVERTY FOR DENVER NEIGHBORHOODS, N = 75

| | Model 1 Change in percent Hispanic | | | Model 2 Change in percent Black | | | Model 3 Change in poverty rate | |
|--|--|-------|-----|------------------------------------|-------|-----|-----------------------------------|---------|
| | B | SE | | B | SE | | B | SE |
| Number of medical marijuana dispensaries | -0.964 | 0.250 | *** | 0.114 | 0.216 | | -0.296 | 0.201 |
| Spatial medical marijuana dispensaries | -1.035 | 0.507 | ** | 0.867 | 0.351 | ** | -0.437 | 0.456 |
| Crime rate per 100 residents | 2.695 | 1.108 | ** | 0.040 | 0.464 | | -1.794 | 0.995 † |
| Residential instability | -0.264 | 0.174 | | 0.136 | 0.094 | | -0.157 | 0.154 |
| Percent residents below poverty | -0.348 | 0.136 | ** | -0.059 | 0.096 | | | |
| Percent voting residents | 0.218 | 0.144 | | 0.173 | 0.102 | † | -0.220 | 0.096 * |
| Median household income | -0.142 | 0.084 | † | 0.011 | 0.041 | | -0.125 | 0.050 * |
| Average home sales price | 1.589 | 1.591 | | 0.510 | 0.964 | | 0.887 | 1.173 |
| Number of major roads | 0.055 | 1.126 | | 3.201 | 0.845 | *** | -0.162 | 1.360 |
| Percent Black | | | | | | | -0.079 | 0.057 |
| Percent Hispanic | | | | | | | 0.029 | 0.036 |
| R ² | | 0.350 | | | 0.302 | | 0.352 | |

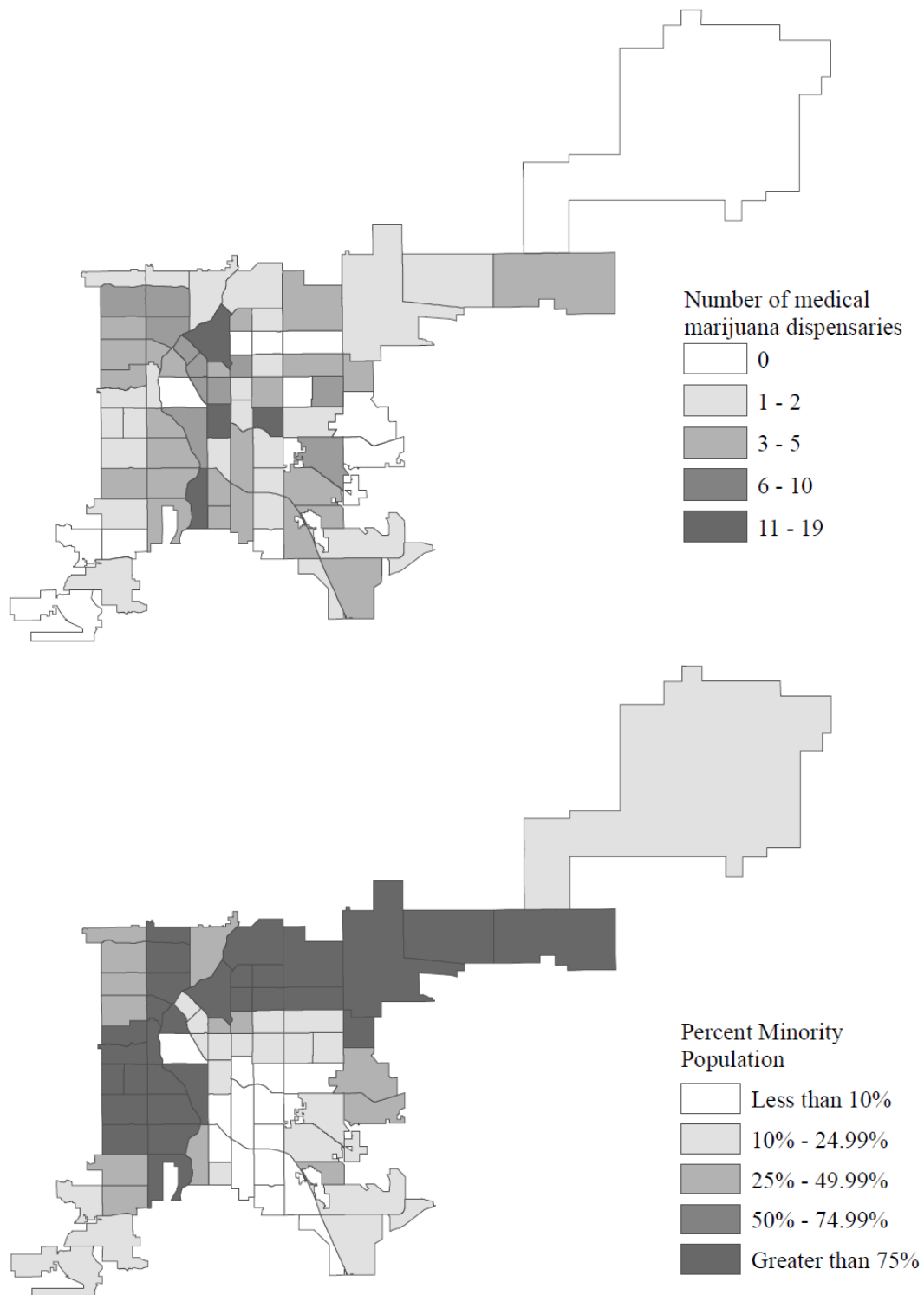
Note: Explanatory and control variables represent values from the year 2000.

†p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001



Figure 1. Typical Medical Marijuana Centers in Denver, Colorado (2010).

Figure 2: Distribution of Medical Marijuana Dispensaries and Percent Minority (2000) in Denver Neighborhoods (N=77)*



*Percent minority includes Black and Hispanic only